

WE CLAIM:

1. A laser modular, narrow band, high repetition rate ultraviolet light source for a production line machine comprising:

- A) a first laser unit comprising:
 - 1) a first discharge chamber containing;
 - a) a first laser gas and
 - b) a first pair of elongated spaced apart electrodes defining a first discharge region,
 - 2) a gas circulation means for producing sufficient gas velocities of said first laser gas in said first discharge region to clear from said first discharge region, following each pulse, substantially all discharge produced ions prior to a next pulse when operating at a repetition rate in the range of 2,000 pulses per second or greater,
 - 3) a first heat exchanger system capable of removing heat energy from said first laser gas, so as to maintain laser gas temperature within a desired range, and
 - 4) a pulse power system configured to provide electrical pulses to said first pair of electrodes sufficient to produce laser pulses at rates of about 2,000 pulses per second or greater with precisely controlled pulse energies in excess of about 5 mJ, and;
- B) a beam delivery unit comprising a beam path enclosure structure providing a laser beam path, from said laser beam output port to laser beam input port at said production line machine;
- C) a laser beam measurement and control system for measuring pulse energy, wavelength and bandwidth of laser output pulses produced by said two chamber laser system and controlling said laser output pulses in a feedback control arrangement; and

D) a purge means for purging said beam path enclosure structure.

2. A light source as in Claim 1 wherein said repetition rate is in the range of 4,000 Hz or greater and said rate of laser pulses is 4000 Hz or greater.
3. A light source as in Claim 2 wherein said source further comprises a second discharge chamber and said first and second discharge chambers are configured in a MOPA configuration.
4. A light source as in Claim 3 and further comprising a pulse stretched for increasing laser pulse duration.
5. A light source as in Claim 4 wherein said pulse duration is increased by at least a factor of 2.
6. A light source as in Claim 1 wherein said beam delivery unit comprises isolation shutter units for isolating portions of said beam path to permit service of optical component while maintaining other portions of the beam path in a substantially contamination free state.
7. A light source as in Claim 1 and further comprising a profile flipping coherence scrambler.
8. A very narrow band two chamber high repetition rate gas discharge laser system comprising:
 - A) a first laser unit comprising:
 - 1) a first discharge chamber containing;
 - c) a first laser gas and
 - d) a first pair of elongated spaced apart electrodes defining a first discharge region,

- 2) a first fan for producing sufficient gas velocities of said first laser gas in said first discharge region to clear from said first discharge region, following each pulse, substantially all discharge produced ions prior to a next pulse when operating at a repetition rate in the range of 4,000 pulses per second or greater,
 - 3) a first heat exchanger system capable of removing at least 16 kw of heat energy from said first laser gas,
 - 4) a line narrowing unit for narrowing spectral bandwidths of light pulses produced in said first discharge chamber;
- B) a second discharge chamber comprising:
- 1) a second laser gas,
 - 2) a second pair of elongated spaced apart electrodes defining a second discharge region
 - 3) a second fan for producing sufficient gas velocities of said second laser gas in said second discharge region to clear from said second discharge region, following each pulse, substantially all discharge produced ions prior to a next pulse when operating at a repetition rate in the range of 4,000 pulses per second or greater,
 - 4) a second heat exchanger system capable of removing at least 16 kw of heat energy from said second laser gas;
- C) a pulse power system configured to provide electrical pulses to said first pair of electrodes and to said second pair of electrodes sufficient to produce laser pulses at rates of about 4,000 pulses per second with precisely controlled pulse energies in excess of about 5 mJ; and
- D) a pulse stretcher for increasing laser pulse duration of said laser pulses in said amplified output beam;

- E) relay optics for directing laser beams produced in said first laser unit through said second discharge chamber to produce an amplified output beam;
 - F) a beam delivery unit comprising a beam path enclosure structure providing a laser beam path from said pulse stretcher to a laser beam input port at said lithography machine; and
 - G) a laser beam measurement and control system for measuring pulse energy, wavelength and bandwidth of laser output pulses produced by said two chamber laser system and controlling said laser output pulses in a feedback control arrangement.
9. A laser as in Claim 8 and further comprising a purge means for purging said beam delivery unit with nitrogen.
10. A light source as in Claim 8 wherein said beam delivery unit is also comprises a plurality of beam path isolation shutter units for isolating portions of said beam path to permit service of optical components while maintaining other portions of the beam path in a substantially contamination free state.
11. A light source as in Claim 8 wherein said beam delivery unit comprises mirrors positioned to provide s-polarization reflection of about 97 percent of laser beam.
12. A light source as in Claim 8 wherein said beam delivery unit comprises two prisms configured to change directions of the laser beam by about 90 degrees.
13. A light source as in Claim 8 wherein a combined beam path is defined by combined paths of laser beams produced in said first laser unit, directed by said relay optics, amplified in said second laser unit, pulse stretched in said pulse stretcher and delivered by said beam delivery unit, and further comprising beam path enclosure components for enclosing all otherwise exposed portions of said beam path.

14. A light source as in Claim 13 and further comprising a purge system for purging with one or more purge gases all portions of said beam path not enclosed in a sealed structure.
15. A light source as in Claim 8 wherein said relay optics are configured to provide two pulses of output pulses from said first laser unit through said second discharge chamber.
16. A light source as in Claim 8 and further comprising a profile flipping coherence scrambler.